NASA Procedural Requirements

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COMPLIANCE IS MANDATORY

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Subject: Facilities Maintenance Management w/ Change 1 (4/21/04)

Responsible Office: Facilities Engineering and Real Property Division

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APPENDIX F. Performance Measurement

1. Facilities Maintenance Management Metrics

This appendix provides maintenance management metrics from various sources. Centers and Component Facilities should consider their use, as applicable, as a means of measuring performance.

1.1 Facility Condition

The annual maintenance funding and resultant trends are a function of the BMAR and the needs of the Center. If the BMAR is high and increasing or staying the same, a positive trend would be observed. A downward trend would be expected if the backlog is low or decreasing. An elimination of the BMAR is not always possible or desirable since BMAR can provide an ability to balance resources in the long term. The following represent the applicable metrics and corresponding benchmarks:

a. $\frac{\text{Annual Maintenance Funding (\$)}}{\text{Current Replacement Value (\$)}}$ should be between 2% - 4%.

b. $\frac{\text{Annual Maintenance Funding (\$)}}{\text{Current Replacement Value (\$)}}$ should show a downward or stabilized trend.

1.2. Work Performance

The following metrics and corresponding benchmarks are used to trend work performance:

a. Emergency Trouble Call Response (hours) should show a downward trend.

b. Emergency Trouble Call Completion (hours) should show a downward trend.

c. Average Completion Time for Routine Trouble Calls (hours) should show a downward trend.

d. Average Completion Time for Repairs (days) should show a downward trend.

e. $\frac{\text{Jobs Completed as Scheduled (Number)}}{\text{Total Jobs Scheduled (Number)}}$ should be 100%.

f. $\frac{\text{Service Requests Completed (Number)}}{\text{Service Requests Committed (Number)}}$ should be 100%.

1.3. Work Element

1.3.1. The following metric may have a positive trend if repair rates are high, equipment/ facilities systems are not realizing their full useful life, and/or there is very little PT&I usage. A negative trend should develop if PT&I is increasing and repair rates are stable or decreasing. The benchmark is between 15% - 18%:

$$\frac{\text{Preventive Maintenance (\$)}}{\text{Total Maintenance Cost (\$)}}$$

1.3.2. The following metric should develop a positive trend as the maintenance program shifts from reactive and time-based maintenance to condition-based maintenance. The benchmark is between 10% - 12%:

$$\frac{\text{Predictive Testing \& Inspection (\$)}}{\text{Total Maintenance Cost (\$)}}$$

1.3.3. The following metrics should develop a negative trend as the maintenance program shifts from reactive and time-based maintenance to condition-based maintenance:

a. $\frac{\text{Programmed Maintenance (\$)}}{\text{Total Maintenance Cost (\$)}}$ should be 25% - 30%.

b. $\frac{\text{Repair (\$)}}{\text{Total Maintenance Cost (\$)}}$ should be 15% - 20%.

c. $\frac{\text{Trouble Calls (\$)}}{\text{Total Maintenance Cost (\$)}}$ should be 5% - 10%.

1.3.4. The following metric should show an upward trend if a backlog of this type of work exists, and a negative trend if not much of this type work exists at the Center. The benchmark is between 15% - 20%:

$$\frac{\text{Replacement of Obsolete Items (\$)}}{\text{Total Maintenance Cost (\$)}}$$

1.3.5. The following metric should show a negative trend demonstrating increased focus on maintenance, and should be distinguished from customer reimbursed Service Requests. The benchmark is between 0% - 5%:

$$\frac{\text{Service Requests (\$)}}{\text{Total Maintenance Cost (\$)}}$$

1.4. RCM Performance Metrics

RCM analysis is an excellent indicator of performance.

1.4.1. Equipment Availability. The following metric is an indicator of equipment availability. The benchmark is 96%:

$$\frac{\text{Hours Each Unit of Equipment is Available to Run at Capacity}}{\text{Total Hours During the Reporting Time Period}}$$

1.4.2. Maintenance Overtime Percentage. The following metric is an indicator of maintenance overtime percentage. The benchmark is 5% or less:

$$\frac{\text{Total Maintenance Overtime Hours During the Period}}{\text{Total Regular Maintenance Hours During the Period}}$$

1.4.3. Emergency Percentage. The following metric is an indicator of the level of effort dedicated to emergency work. The benchmark is 10% or less:

$$\frac{\text{Total Hours Worked on Emergency Jobs}}{\text{Total Hours Worked}}$$

1.4.4. Percent of Candidate Equipment Covered by PT&I. The following metric is an indicator of the amount of candidate equipment covered by PT&I. The benchmark is 100%:

$$\frac{\text{Number of Equipment Items in the PT\&I Program}}{\text{Total Equipment Candidates for PT\&I}}$$

1.4.5. Percent of Emergency Work to PT&I and PM Work. The following metric is an indicator of the amount of emergency work relative to PT&I and PM work. The benchmark is 20% or less:

$$\frac{\text{Total Emergency Hours}}{\text{Total PT\&I and PM Hours}}$$

1.4.6. Percent of Faults Found in Thermographic Survey. The following metric is an indicator of the percent of faults found through infrared thermography. The benchmark is 3% or less:

$$\frac{\text{Number of Faults Found}}{\text{Number of Devices Surveyed}}$$

1.4.7. Percent of Faults Found in Steam Trap Survey. The following metric is an indicator of the percent of faults found during steam trap surveys. The benchmark is 10% or less:

$$\frac{\text{Number of Defective Steam Traps Found}}{\text{Number of Steam Traps Surveyed}}$$

1.4.8. Ratio of PM/PT&I Work to Reactive Maintenance Work. The following metric is an indicator of the percentage of planned work relative to unplanned work:

A = 70% PM/PT&I
B = 30% Reactive Maintenance

where,

$$A\% = \frac{\text{Manhours of PM/PT \& I Work}}{\text{Manhours of Reactive + PM/PT \& I Work}}$$

$$B\% = \frac{\text{Manhours of Reactive Work}}{\text{Manhours of Reactive + PM/PT \& I Work}}$$

$$A\% + B\% = 100\%$$

2. Budget Execution

The following metrics indicate how well the facilities maintenance budget is being executed:

a. $\frac{\text{Prior Year Execution (\$)}}{\text{Prior Year Budget (\$)}}$ should be 100%.

b. $\frac{\text{Current Year Expenditures to Date (\$)}}{\text{Current Year Budget to Date (\$)}}$ should be 100%.

3. Other Metrics

The following are miscellaneous metrics used by organizations to measure performance. Their use by Centers is highly encouraged:

a. $\frac{\text{New Construction + Service Requests}}{\text{PM + PT\&I + PGM + Repairs + ROI}}$ or $\frac{\text{New Work (\$ or hours)}}{\text{Maintenance (\$ or hours)}}$

should show a downward trend.

b. $\frac{\text{Repairs + Trouble Calls}}{\text{PM + PT\&I + PGM + ROI}}$ or $\frac{\text{Corrective Actions (\$)}}{\text{Preventive Actions}}$

should show a downward trend.

c. $\frac{\text{Maintenance Backlog (BMAR) (\$)}}{\text{CRV (\$)}}$ should be less than 5%

d. $\frac{\text{Average Age of Equipment (years)}}{\text{Average Useful life of Equipment (years)}}$ should show a downward trend.

e. The number of disabling accidents per year should show a downward trend.

f. The number of routine trouble calls per year should show a downward trend.

g. The number of Work Orders per year or month should show a downward trend.

h. The number of emergency trouble calls per year or month should show a downward trend.

i. Customer Satisfaction, as measured by a numerical grade assigned to positive or negative feedback should show a positive, or upward, trend.

j. The number of unplanned electric power outages should show a downward trend.

k. The number of environmental violations should be zero.

l. The number of OSHA violations should be zero.

m. Maintenance Overtime (hours) / Total Maintenance (hours) should be less than 10% of payroll costs.

n. PM's Completed (number) / PM's Scheduled (number) should show an upward trend.

o. Scheduled Work (hours) / Total Work (hours) should not exceed a locally determined benchmark.

p. Actual Cost of Work ($) / Estimated Cost of Work ($) should be ± 10%.

q. Jobs Planned and Estimated (number) / Total Jobs (number) should not exceed a locally determined benchmark.

r. Jobs Planned and Estimated ($) / Total Jobs ($) should not exceed a locally determined benchmark.

s. Requisitions Met from Stock (number) / Total Requisitions (number) should not exceed a locally determined benchmark.

t. Requisitions not in stock (number) / Total Requisitions (number) should not exceed a locally determined benchmark.

u. Supervision (hours) / Direct Labor (hours) should be less than 10%.

v. Downtime Caused by Breakdown (hours) / Total Downtime (hours) should not exceed a locally determined benchmark.

w. Breakdown Labor (hours) / Total Labor (hours) should show a downward trend.

x. Maintenance Cost ($) / Center Mission Cost ($) should not exceed a locally determined benchmark.

3.1. The following two metrics must be carefully used and on a job-by-job or like-work basis. This may create conflict between shops and management. Care should be exercised to preclude adversarial relationships between the shops and management.

a. Actual Hours per Job (hours) / Scheduled Hours per Job (hours) should be ± 10%.

b. Maintenance Work Orders Completed (number) / Maintenance Work Planned & Scheduled (number) should show an upward trend.

3.2. The following two metrics should be trended with the locally accepted employment index factor:

a. Material Cost ($) / Direct Labor Cost ($) should not exceed a locally determined benchmark.

b. Maintenance Cost ($) / Total Maintenance Workhours (hours) should not exceed a locally determined benchmark.

3.3. Metric 3.2.b., when evaluated with metric 3.3.a. below, will help determine peaks of work resulting from the Center mission or weather related work. This evaluation can help in the planning process and use of alternative labor or contract methods.

a. The monthly cost of maintenance operations should not exceed a locally determined benchmark.

b. Equipment Covered by PT&I (number) / Items of Equipment Potential for PT&I (number) should show an upward trend.

3.4. A downward trend of the spare parts inventory is desirable provided that the maintenance response time and completion times are not adversely affected. Given that, the desired metric is the following:

a. The inventory value of spare parts should show a downward trend.

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